APPENDIX G:

Cumulative Effects Model

Activity Coordination Analysis

Because of the abundance and diversity of wildlife populations inhabiting the Rocky Mountain Front and the increased demand for utilizing other natural resources, a method was needed to evaluate the impacts and provide a tool to coordinate management activities with wildlife habitat.

Therefore, an analysis process was developed. Termed "Activity Coordination Analysis", this analysis process utilizes computer technology to overlay and compare maps of suitability for different management activities with habitat maps of various wildlife species to define suitable operating areas and suitable timing windows for management activities under consideration. The computer overlay and comparison process uses the Geographical Information System (GIS) technology to make the necessary comparisons.

Using GIS technology, allows the manager to digitize any type of information that can be mapped and enter it into the computer as an overlay. The computer can then combine various overlays to produce a map of the information desired. By using GIS technology, it is possible to combine large numbers of overlays for a wide range of wildlife species and compare them to terrain suitability for various types of activities.

A GIS system was developed with the following layers (or overlays) as a basis for the analysis.

1. Land ownership and administrative boundaries.
2. Maps of oil and gas leases.
3. Maps of lease stipulation restrictions.
4. Maps of existing management features and activities (roads, trails, outfitter camps, range allotments, timber sales, etc.)
5. A digital terrain model which enables predictive determinations based on slope, elevation, and aspect.
6. Maps of existing seasonal restrictions for various activities which are defined in the Interagency Wildlife Guidelines.
7. Maps of grizzly habitat components within BMU (Bear Management Units).
8. Maps of grizzly protein sources.
9. Maps of landtypes on the Lewis and Clark National Forest.
10. Other layers as needed.

Once the information is entered into the computer the manager can then use GIS technology to compare proposed activities to existing activities and evaluate the positive or negative impacts. The computer can generate maps to display areas that have conflicting, complementary, or no effect of land uses on wildlife habitat.

For most wildlife species the computer analysis will be complete once the physical suitability for the activity the Rocky Mountain Front Interagency Wildlife Guidelines. However, in the case of the threatened grizzly bear, a more sophisticated process will be used. In order to effectively meet goals to recover the grizzly bear population in the Northern Continental Divide Ecosystem and to meet the needs for formal consultation with U.S. Fish and Wildlife Service, the analysis will be carried further using a computer model to predict the cumulative effects of management activities on the grizzly bear. This cumulative effects analysis will be completed on a Bear Management Unit basis.

Cumulative Effects and Analysis

The Cumulative Effects Model (CEM) will draw certain information from the GIS and use that information to make calculations concerning the cumulative effects of management activities on the grizzly bear. The CEM is composed of three submodels which combine to produce the final output. These submodels are: 1) the habitat submodel, 2) the displacement submodel, and 3) the mortality submodel.

The habitat submodel is based on a map of grizzly bear vegetative units generated either by field mapping, mapping an aerial photographs, or digital maps prepared from LANDSAT imagery or other sources. Each vegetative unit was assigned a coefficient between 0 and 1. This rating defines the usefulness of the vegetative unit as both food and cover (separate rating for each) for the spring, summer and fall season of use by grizzly bears.

Adjustments can also be made in food ratings where the particular vegetative unit coincides with bear protein sources (i.e., deer and elk winter ranges, domestic boneyards and winter pastures where there is a source of carrion during the spring). The output of the habitat submodel is a quantitative rating of the Bear Management Unit in terms of bear habitat quality.

The displacement submodel quantifies the effects of displacement associated with human uses or activities on the grizzly bear's ability to use a specific habitat. Interaction of the displacement submodel with the habitat submodel results in an index of habitat effectiveness.

To develop the displacement submodel, human activities and uses which occur along the Rocky Mountain Front were stratified into groups having similar displacement potentials. Each activity group was then assigned a zone of influence (either a given distance or the distance to an intervening ridgeline, whichever came first). Displacement coefficients (0-1) were also assigned to each of the activities

The results of the displacement submodel and the habitat submodel are then merged to develop an index of habitat effectiveness. These changes in habitat effectiveness can be used to display the effects of various management activities or to display changes in effects from changing the timing of an activity (spring habitat effectiveness might increase by scheduling the activity during the summer for example).

The third submodel quantifies the risk of mortality associated with human activities and associated risks of mortality. These are point, linear and dispersed categories similar to those in the displacement submodel. These were then further characterized by the type of use. Each was then assigned a coefficient of 0-1. This coefficient was then modified by the amount of cover in the area. This can then be merged with the other two submodels to provide and overall rating of the cumulative effects on grizzly bears.